FORM PTO-1390 (REV 10-2000) U S DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE

TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371

ATTORNEY'S DOCKET NUMBER: 1749/270 (205259)

U S APPLICATION NO (If known, see 37 C.F R 1.5): To be Assigned 09/673598

INTERNATIONAL APPLICATION NO	INTERNATIONAL FILING DATE	PRIORITY DATE CLAIMED
PCT/GB99/01365	April 30, 1999	May 1, 1998

TITLE OF INVENTION

"Image Capture Control"

APPLICANT(S) FOR DO/EO/US

Jonathan Ephriam David Hurwitz; Peter Brian Denyer

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. ☒ This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. ☒ This is an express request to promptly begin national examination procedures (35 U.S.C. 371(f)).
4. ☐ The US has been elected by the expiration of 19 months from the priority date (PCT Article 31).
5. ☒ A copy of the International Application as filed (35 U.S.C. 371(c)(2))
   a. ☒ is attached hereto (required only if not communicated by the International Bureau).
   b. ☐ has been communicated by the International Bureau.
   c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US).
6. ☐ A English language translation of the International Application as filed (35 U.S.C. 371(c)(2)).
7. ☒ Amendments to the claims of the International Application under PCT Article 19 (35 U S.C. 371(c)(3))
   a ☒ are attached hereto (required only if not communicated by the International Bureau)
   b. ☐ have been communicated by the International Bureau.
   c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
   d. ☐ have not been made and will not be made.
8. ☐ An English language translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
9. ☒ An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).
10. ☐ An English language translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).

Items 11. To 16. Below concern other document(s) or information included:

11. ☒ An Information Disclosure Statement under 37 C.F.R. 1.97 and 1.98.
12. ☒ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
13. ☒ A FIRST preliminary amendment.
    ☐ A SECOND or SUBSEQUENT preliminary amendment.
14. ☐ A substitute specification.
15. ☐ A change of power of attorney and/or address letter.
16. ☒ *Other items or information:* International Preliminary Examination Report; Request

09/673598

528 Rec'd PCT/PTO 18 OCT 2000

U.S. APPLICATION NO (If known, see 37 C F R 1 50)	INTERNATIONAL APPLICATION NO	ATTORNEY'S DOCKET NUMBER	
To be assigned	PCT/GB99/01365	1749/270 (205259)	
17. ☒ The following fees are submitted:		CALCULATIONS	PTO USE ONLY
Basic National Fee (37 CFR 1.492(a)(1)-(5)): Neither international preliminary examination fee (37 CFR 1.482) nor International search fee (37 CFR 1.445(a)(2)) paid to USPTO and International Search Report not prepared by the EPO or JPO **$1,000.00**			
International preliminary examination fee (37 CRF 1.482) not paid to USPTO but International Search Report prepared by the EPO or JPO **$860.00**		**$ 860.00**	
International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search (37CFR 1.445(a)(2)) paid to USPTO **$710.00**			
International preliminary examination fee (37 CFR 1.482) paid to USPTO But all claims did not satisfy provisions of PCT Article 33(1)-(4) **$690.00**			
International preliminary examination fee (37 CFR 1.482) paid to USPTO and all claims satisfied provisions of PCT Article 33(1)-(4) **$ 100.00**			
ENTER APPROPRIATE BASIC FEE AMOUNT =		**$ 860.00**	
Surcharge of **$130.00** for furnishing the oath or declaration later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492(e)).		**$ -0-**	
CLAIMS	NUMBER FILED / NUMBER EXTRA / RATE		
Total Claims	15 -20 = 0 X $18.00	**$ 0.00**	
Independent Claims	4 - 3 = 1 X $80.00	**$ 80.00**	
MULTIPLE DEPENDENT CLAIM(S) (if applicable)	+ $270.00	**$ -0-**	
TOTAL OF ABOVE CALCULATIONS =		**$ 940.00**	
☐ Applicant claims small entity status. See 37 CFR 1.27. The fees indicated above are reduced by one-half.		**$ -0-**	
SUBTOTAL =		**$ 940.00**	
Processing fee of **$130.00** for furnishing the English translation later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492(f)).		**$**	
TOTAL NATIONAL FEE =		**$ 940.00**	
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). **$40.00** per property +		**$ 40.00**	
TOTAL FEES ENCLOSED =		**$ 980.00**	
		Amount to be Refunded	**$**
		Charged	**$**

a. ☒ A check in the amount of $980.00 to cover the above fees is enclosed.

b. ☐ Please charge my Deposit Account No. 16-0605 in the amount of $ to cover the above fees. A duplicate copy of this sheet is enclosed.

c. ☒ The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 16-0605.

Note: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137 (a) or (b)) must be filed and granted to restore the application to pending status.

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"Express Mail" Mailing Label Number: EL618192188US
Date of Deposit: October 18, 2000

I hereby certify that this paper or fee is being deposited with the United States Postal Service "Express Mail Post Office to Addressee" service under 37 CFR 1.10 on the date indicated above and is addressed to BOX PCT, Attn. DO/US (PTO) Assistant Commissioner for Patents, Washington, DC 20231.

Lorna Morehead

CLT01/4448017v1

Attorney's Docket No. 1749/270 (205259)

IN THE UNITED STATES DESIGNATED OFFICE (DO/US)

In re:	Jonathan Ephriam David Hurwitz, Peter Brian Denyer	
International Appl. No.:	PCT/GB99/01365	Attn: DO/US
International Filing Date:	April 30, 1999	
For:	"Image Capture Control"	

Box PCT
Assistant Commissioner of Patents
Washington, DC 20231

October 18, 2000

PRELIMINARY AMENDMENT

Sir:

Please amend the claims (claims 1-13 as filed with letter of June 11, 1999 and attached to the Examination Report) in the above-identified application as follows:

In The Claims:

Claims 1-13, remove all reference characters.

Claim 5, line 1, delete "any of claims 1 to 4" and insert therefor -- claim 1 --.

Claim 6, line 1, delete "any of claims 1 to 4" and insert therefor -- claim 1 --.

Claim 8, line 1, delete "5" and insert therefor -- 7 --.

Claim 9, lines 1 and 2, delete "5 or claim 6" and insert therefor -- 7 --.

Claim 10, lines 1 and 2, delete "any of claims 7 to 9" and insert therefor -- claim 7 --.

Claim 11, lines 1 and 2, delete "any of claims 7 to 9" and insert therefor -- claim 7 --.

Claim 12, lines 2 and 3, delete "any of claims 7 to 11" and insert therefor -- claim 7 --.

Please add the following new claims 14 and 15:

14. A method according to claim 3, wherein the asynchronous stimulus is the opening of a camera shutter.

15. A method according to claim 3, wherein the asynchronous stimulus is a flash of light from a lighting strobe.

Remarks

The above amendments are made to more clearly define the invention under United States practice. Please enter this amendment prior to calculation of the filing fee.

Respectfully submitted,

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CERTIFICATE OF EXPRESS MAILING

"Express Mail" mailing label number EL618192188US
Date of Deposit October 18, 2000

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Lorna Morehead

CLT01/4448007v1

IMAGE CAPTURE CONTROL

This patent application relates to techniques for acquiring images from a solid-state imager when exposure to the scene is controlled by either an asynchronous lighting strobe, or by the asynchronous opening of a shutter. The techniques that we describe do not require an electronic connection between the strobe/shutter and the sensor in order to work, and are hence applicable for use in systems where there is a physical reason, or an electronic reason, why this connection is not feasible.

Solid state image sensors dominate electronic imaging applications such as CCTV, video cameras and camcorders, and scanners, and are the basis of newly developed markets such as PC-cameras for videoconferancing, medical vision, machine vision and Digital Stills Cameras.

One popular form of image sensor is the Charge Coupled Device (CCD), whilst sensors built entirely within standard CMOS processes are also gaining currency. Both have their relative merits when applied to these techniques.

As used herein the expression "asynchronous stimulus" means a stimulus the timing of whose occurrence is not known in advance and which stimulus is associated with the presentation of an image to be captured to the solid state image sensor. As discussed herein various kinds of solid state image sensors known in the art may be used in the present invention, including CCD sensors as well as sensors such as those disclosed in our earlier patent publication WO91/04633, in which, following a resetting of the sensing cells, charge is built up on the sensing cells in response to incident

radiation impinging thereon and the built up charge subsequently converted into a voltage signal during an integration period, and this cycle repeated upon the next resetting of the sensing cells.

In some systems it is desirable to separate the operation of the sensor from the exposure mechanism. One such application is Electronic Film, for use in conventional Silver Halide Cameras such as 35mm SLR (Single Lens Reflex). Here the solid state sensor replaces the chemical film within the camera, and as with chemical film the exposure is controlled by the shutter of the camera. In order that such an Electronic Film can work without user modification of the camera to access the shutter control signal, or with older non-electronic cameras, it is necessary for the sensor to auto-detect that it has been exposed. This system must offer a high probability of successful detection, and be scene independent, working under the widest possible range of camera exposures, and additional operating conditions such as flash and fill-in flash.

Another application is in medical vision and in machine vision, where exposure/illumination occurs through an illumination strobe, and there are physical or electronic reasons why a synchronisation pulse between the light source and the sensor cannot occur. For example it may be necessary to isolate the light source from the detector for reasons of safety, as in an X-ray system.

Fig. 1 shows a conventional general imaging system incorporating a solid state image sensor 1 (incorporating an array of sensing cells) with a shutter 2(electronic, mechanical or electromechanical), a lighting strobe 3, and a detector 4. The imaging system also includes strobe/shutter

control means 5, and sensor timing and detector control means 6. There is no timing interaction between the strobe/shutter control means 5, and the sensor timing and detector control means 6.

The shutter 2 and/or the lighting strobe 3 provide means of asynchronous stimulation of the image sensor 1 in order to capture an image of an object 7 . The classic approach to the problem would be try to detect the asynchronous event and to then subsequently instigate an exposure and acquisition sequence for the image sensor. The problem with this approach is that it puts design pressure on achieving an asynchronous event detector that is sufficiently fast and reliable that the interaction between activating the image sensor and the asynchronous stimulus does not corrupt the effective exposure. Fig. 2 shows a timing diagram of an image acquisition sequence commonly used with the imaging system of Fig.1, where the detector triggers the release from reset of the array of the sensor 1, putting it into integration. The array is then read when the stimulus has gone away. In this example the solid state image sensor 1 and the detector 4 see the stimulus simultaneously, as in the case of a lighting strobe 3. As can be seen the time for the detector to trigger, Td, reduces the effective amount of the stimulus, Ts, to an amount Te, that is approximately equal to:-

$$Te = Ts - Td$$

If there is a spatial distance between the detector 4 and the image plane of the solid state sensor 1 with respect to the stimulus, as in the case of a blade shutter 2 in an SLR camera, then the detector trigger time Td can result in a gradient of exposure across the array of the sensor 1. Fig. 2b shows an example of what would happen to an array if the

detector 4 was located to the left hand side of the array, and the shutter 2 was opening from the right hand side of the array. If Tsh1 is the time the shutter takes to cross the array and Tsh2 is the subsequent time for the shutter to pass from the array to the detector, then as the diagram shows the two sides of the array see different effective stimuli, Te1 and Te2, as defined by:-

$Te1 = Ts-Td-Tsh1-Tsh2$

$Te2 = Ts-Td-Tsh2$

This problem can be reduced by using detectors on the side of the shutter that opens first, but still if the time to detect Td is greater than the time to reach the array Tsh2, then there will be a gradient of exposures across the array. The effective stimuli will be somewhere between the following values:-

$(Ts-Tsh) < Te < (Ts-Td)$, where $Tsh2 > Td$

dependant on the position in the array. This is clearly undesirable.

We describe a more radical approach to the problem that greatly increases the probability of successful detection of the asynchronous event with no degradation of the stimulus.

Thus, according to one aspect of the present invention we provide a method of operating a solid state image sensor for the acquisition of an image generated by an asynchronous stimulus, wherein said image sensor is operated in conjunction with at least one detector which, directly or indirectly, detects the said asynchronous stimulus, said image sensor is regularly reset so as to commence integration from a reset state of the sensor each time a predetermined period has elapsed, and an output from said at least one detector prior

to each reset is used to determine whether that reset is inhibited or not.

According to a further aspect of the invention we provide a method of using a solid state image sensor, comprising an array of sensing cells, for the acquisition of an image generated by an asynchronous stimulus, wherein said image sensor is regularly reset so as to commence integrating from a reset state of the sensor each time a predetermined period has elapsed, and wherein a portion of the array of the sensor is read prior to each said reset and the value of this read is used to determine whether the subsequent reset should be inhibited or not.

According to yet another aspect of the present invention we provide image capture control apparatus suitable for use with a solid state image sensor for the acquisition of an image presented to the sensor in response to an asynchronous stimulus, said apparatus comprising at least one detector means formed and arranged for detecting, in use of the apparatus, directly or indirectly, a said asynchronous stimulus, and reset inhibition control signal output means formed and arranged for generating a reset inhibition control signal in response to detection of said asynchronous stimulus and supplying it, directly or indirectly, in use of the apparatus, to a reset signal generating means operatively coupled to said solid state image sensor, so as to inhibit the application of at least one subsequent reset signal to the sensor.

The image capture control apparatus may be provided in a single device. Alternatively, the apparatus may be provided in the form of separate modules.

In a further aspect the present invention provides a camera having a solid state image sensor, wherein is provided image capture control apparatus as above-described.

Preferred embodiments of the invention will now be described by way of example only and with reference to the accompanying drawings in which:

Fig.1 is a schematic diagram of an imaging system incorporating a solid state sensor exposed to an asynchronous stimulus;

Fig.2a is a diagram showing the relative timing of various operations carried out in a conventional method of operating the system of Fig.1;

Fig.2b is a diagram showing the relative timing of various operations carried out in a further known prior art method of operating the system of Fig.1;

Fig.3a is a diagram of the relative timing of various operations carried out in a method of operating the system of Fig.1 according to the present invention, where an asynchronous event occurs in a "detect period" Tr;

Fig.3b is a diagram of the relative timing of various operations carried out in a method of operating the system of Fig.1 according to the present invention, where the asynchronous event straddles two detect periods Tr;

Fig.3c is a diagram of the relative timing of various operations carried out in a method of operating the system of Fig.1 according to the present invention, where the asynchronous event occurs close to the end of the detect period Tr;

Fig.4 is a diagram of the relative timing of various operations carried out in another method of operating the system of Fig.1 according to the present invention, in which a

portion of the sensor array is used to detect the asynchronous stimulus; and

Fig.5 is a block diagram of one embodiment of image capture control apparatus for carrying out the method of the invention.

The method of the invention can be briefly described in the following manner, with reference to the imaging system of Fig.1:-

a) The image sensor is regularly reset, at a repetition rate of 1/Tr. The period Tr between each reset pulse R is hereinafter referred to as the detect period Tr. In this period Tr between the reset pulses R the image sensor 1 is integrating any incident light.

b) If during a given detect period Tr the detector 4 has fired, indicating that there has been some asynchronous stimulus, which is of duration Ts, then the next reset pulse R' is inhibited, and the sensor enters its "continued integration period", Tc.

c) In the continued integration period, Tc, the integration of the array is continued to beyond the extent of the longest asynchronous stimulation, Ts(max). This may either be a fixed time or a time based on a trigger by a detector that the stimulus has gone away. The sensor now enters the readout period.

d) In the array readout period, Ta, the array is readout, and can then go back to the detect period Tr to await the next asynchronous event (i.e. stimulus).

We have called this approach the 'inhibited reset' approach.

Fig 3a shows the basic timing for an asynchronous event S that occurs totally inside the detect period Tr, and Fig 3b an

event S that would straddle a reset pulse R (hereinafter referred to as a "reset" R), but for the 'inhibited reset' (i.e. the event S straddles the inhibited reset R'). The time for the detector to fire is Td, and the probability of acquiring the asynchronous event without any corruption is :-

Probability of success = (Tr-Td)/Tr and normally Tr >> Td

Note in both cases the effective exposure, Te3, seen by all of the array and the detector is the full time of the stimuli,

Te3 = Ts

Fig 3c shows the case where the stimulus occurs < Td away from where the reset R would occur. In this case the reset R would NOT be inhibited in time, but it is important to note that this is no worse than the classic approach described earlier with reference to Fig.2c.

In this case the effective exposure, Te4 is :-

Te4 = Ts - Td

Fig.5 illustrates schematically one embodiment of image capture control apparatus for implementing the above-described method of the invention. The apparatus 10 comprises the detector 4, a reset signal generating unit 11 for generating the reset signals R, and reset inhibition control signal output means 12 for generating a reset inhibition control signal for supplying to the reset signal generating unit 11. When the detector 4 detects an asynchronous stimulus it outputs a detection signal D (see Fig.3) to the reset inhibition control signal output means 12 which generates a reset inhibition control signal Cr which is supplied to the

reset signal generating unit 11 so as to inhibit the application of the subsequent reset pulse R' to the sensor array. It will be appreciated that the reset inhibition control signal output means 12, if desired, may be incorporated in the detector 4 (e.g. in a single device), or may be incorporated in the reset signal generating unit 11, or may be provided as a separate module. Similarly, the reset signal generating unit 11 may be incorporated in the sensor 1. Equally, the apparatus 10 may together be incorporated in the image sensor 1, if desired, or may be provided as one or more separate modules for use therewith.

The detector 4 in both the classic approach and the 'inhibited reset' approach need not be a direct detector, i.e. another optical sensor that is also looking for the same type of optical stimuli, although this is by far the most popular approach. An example of an indirect detector which could be used is a vibration transducer, or a sound transducer, for detecting the movement of a physical shutter.

In the case of the optical detector 4, it is often co-located with the image sensor 1, but it is not possible to put it in the same focal plane as the image sensor. This can give problems in a lensed system as the detector may not be focused on a part of the scene with sufficient luminance to trigger it.

However, with our 'Inhibited reset approach' it is possible to use a sub-sampled portion of the sensor array, in such a way that the sensor array itself can act as the detector of the asynchronous stimulus. This is because the array is already integrating during its detect period, therefore by reading it before the decision to inhibit reset or not, we have a sample

of the light that has been integrated by the array. By comparing these values with the values obtained when there has been no stimulus, we have a measure of the change. If this change is greater than a user defined threshold, then we say that an asynchronous stimulus has occurred. The choice of this threshold, relative to the lowest energy stimulus it is desired to detect, determines the effective time to detect, Td, in the following way. With reference to Fig.4, if Ts is the longest stimuli to cause saturation of the image sensor, Tsa is the time to read the sub-array, and Pt is the percentage of saturation that is required to trigger a threshold of detection, then the effective Td is

$$Td = (Ts * Pt) + Tsa$$

The major advantage of this approach is that the array itself is acting as the detector and is therefore in the focal plane of the focused image. Spatially distributing the sub-sample, greatly increases the probability that some of the pixels of the sub-sample are in areas with sufficient luminance.

It is of course possible to use our described 'Inhibited reset approach' with a plurality of detectors and sub-sampled arrays, to determine if an asynchronous event has occurred.

Various other modifications and variations of the above-described embodiments are also possible without departing from the scope of the invention. For example, in relation to the continued integration period, Tc, it will be appreciated that this could be an extended period corresponding in effect to the inhibition of more than one reset pulse i.e. a series of successive reset pulses.

CLAIMS

1. A method of operating a solid state image sensor (1) for the acquisition of an image presented to the sensor in response to an asynchronous stimulus (S), wherein said image sensor is operated in conjunction with at least one detector (4) which, directly or indirectly, detects the said asynchronous stimulus, said image sensor is regularly reset so as to commence integration from a reset state of the sensor each time a predetermined period (Tr) has elapsed, and an output from said at least one detector prior to each reset (R) determines whether that reset is inhibited or not in that if said output represents the detection of said asynchronous stimulus then said reset is inhibited.

2. A method according to claim 1 wherein the detector outputs a detection signal (D) when said asynchronous stimulus (S) is detected, and said detection signal (D) is used to trigger a reset inhibition control signal (Cr) for inhibiting a subsequent reset signal (R') to the sensor.

3. A method of using a solid state image sensor (1). comprising an array of sensing cells, for the acquisition of an image presented to the sensor in response to an asynchronous stimulus (S), wherein said image sensor is regularly reset so as to commence integrating from a reset state of the sensor each time a predetermined period (Tr) has elapsed, and wherein a portion of the array of the sensor (1) is read prior to each said reset (R) and the value of this read is used to determine whether a subsequent reset (R') signal to the sensor should be inhibited or not in that if said value indicates the occurrence of an asynchronous stimulus then said subsequent reset signal (R') is inhibited.

4. A method according to claim 3, wherein said portion of the array read prior to each reset (R) comprises a plurality of sensing cells which are spatially distributed throughout the

array of sensing cells.

5. A method according to any of claims 1 to 4 wherein the asynchronous stimulus is the opening of a camera shutter.

6. A method according to any of claims 1 to 4 wherein the asynchronous stimulus is a flash of light from a lighting strobe.

7. Image capture control apparatus suitable for use with a solid state image sensor (1) for the acquisition of an image presented to the sensor in response to an asynchronous stimulus (S), said apparatus comprising at least one detector means (4) formed and arranged for detecting, in use of the apparatus, directly or indirectly, a said asynchronous stimulus (S), and reset inhibition control signal output means (12) formed and arranged for generating a reset inhibition control signal in response to detection of said asynchronous stimulus (S) and supplying it, directly or indirectly, in use of the apparatus, to a reset signal generating means (11) operatively coupled to said solid state image sensor, so as to inhibit the application of at least one subsequent reset signal (R') to the sensor.

8. Image capture control apparatus according to claim 5, wherein said at least one detector means (4) and said reset inhibition control signal output means (12) are provided in a single device.

9. Image capture control apparatus according to claim 5 or claim 6, wherein said reset inhibition control signal output means (12) and said reset signal generating means (11) are provided together in a single device.

10. Image capture control apparatus according to any of claims 7 to 9 wherein the detector is formed and arranged for detecting the opening of a camera shutter.

11. Image capture control apparatus according to any of claims 7 to 9 wherein the detector is formed and arranged for detecting a flash of light from a lighting strobe.

12. A camera having a solid state image sensor, wherein is provided image capture control apparatus according to any of claims 7 to 11.

13. Image capture control apparatus suitable for use with a solid state image sensor (1) for the acquisition of an image presented to the sensor in response to an asynchronous stimulus (S), said apparatus comprising at least one detector means (4) formed and arranged for detecting, in use of the apparatus, directly or indirectly, a said asynchronous stimulus (S), and reset signal generating means (11) operatively coupled to said solid state image sensor for regularly resetting the image sensor, in use of the apparatus, so that the sensor commences integrating from a reset state thereof each time a predetermined period (Tr) has elapsed, reset inhibition control signal output means (12) formed and arranged for generating a reset inhibition control signal in response to detection of said asynchronous stimulus (S) and supplying it, directly or indirectly, in use of the apparatus, to said reset signal generating means, so as to inhibit the application of at least one subsequent reset signal (R') to the sensor.

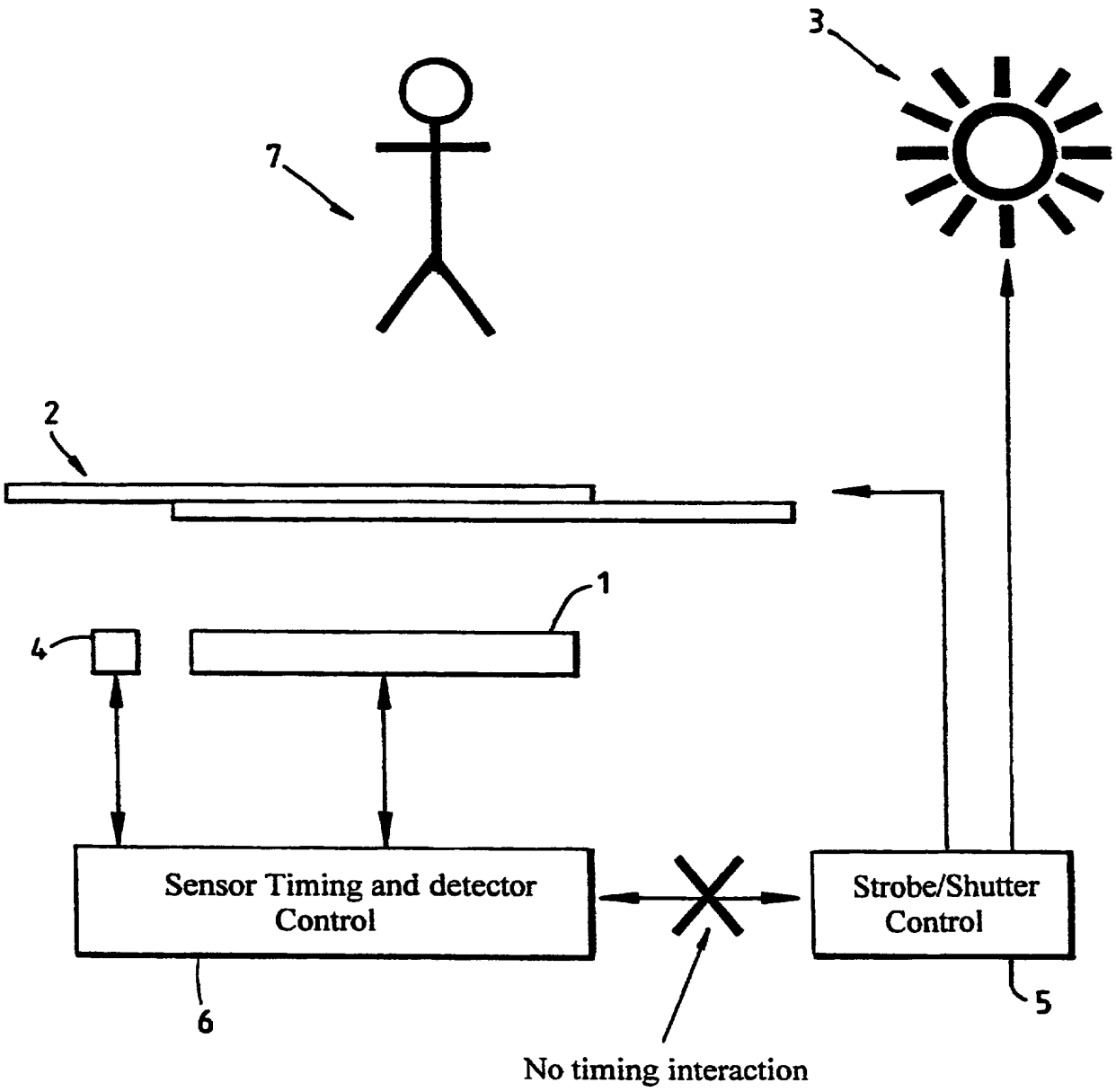
3
7
2
1
4
Sensor Timing and detector Control
Strobe/Shutter Control
6
5
No timing interaction

Fig. 1

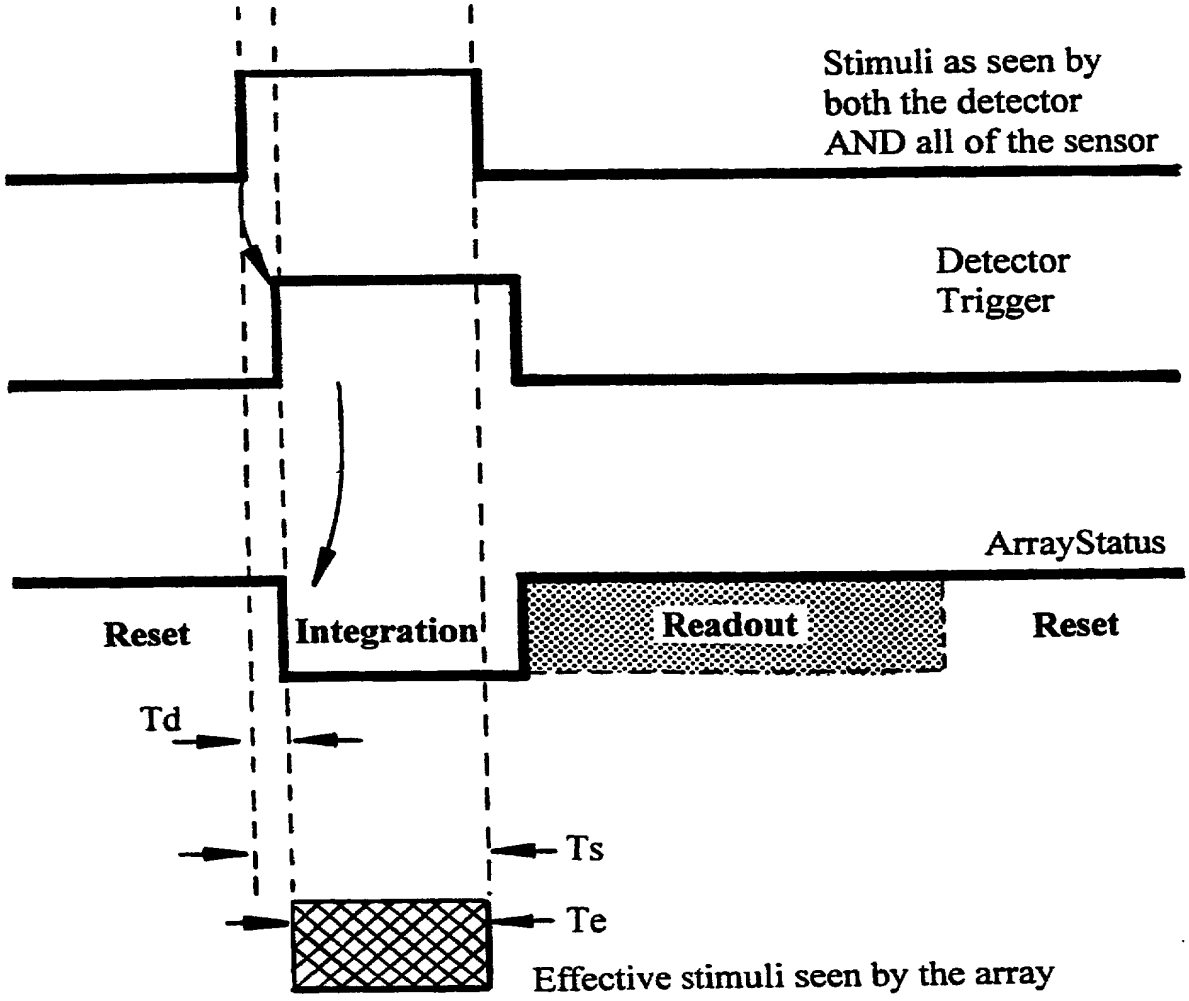
Stimuli as seen by
both the detector
AND all of the sensor
Detector
Trigger
ArrayStatus
Reset
Integration
Readout
Reset
Td
Ts
Te
Effective stimuli seen by the array

Fig. 2a

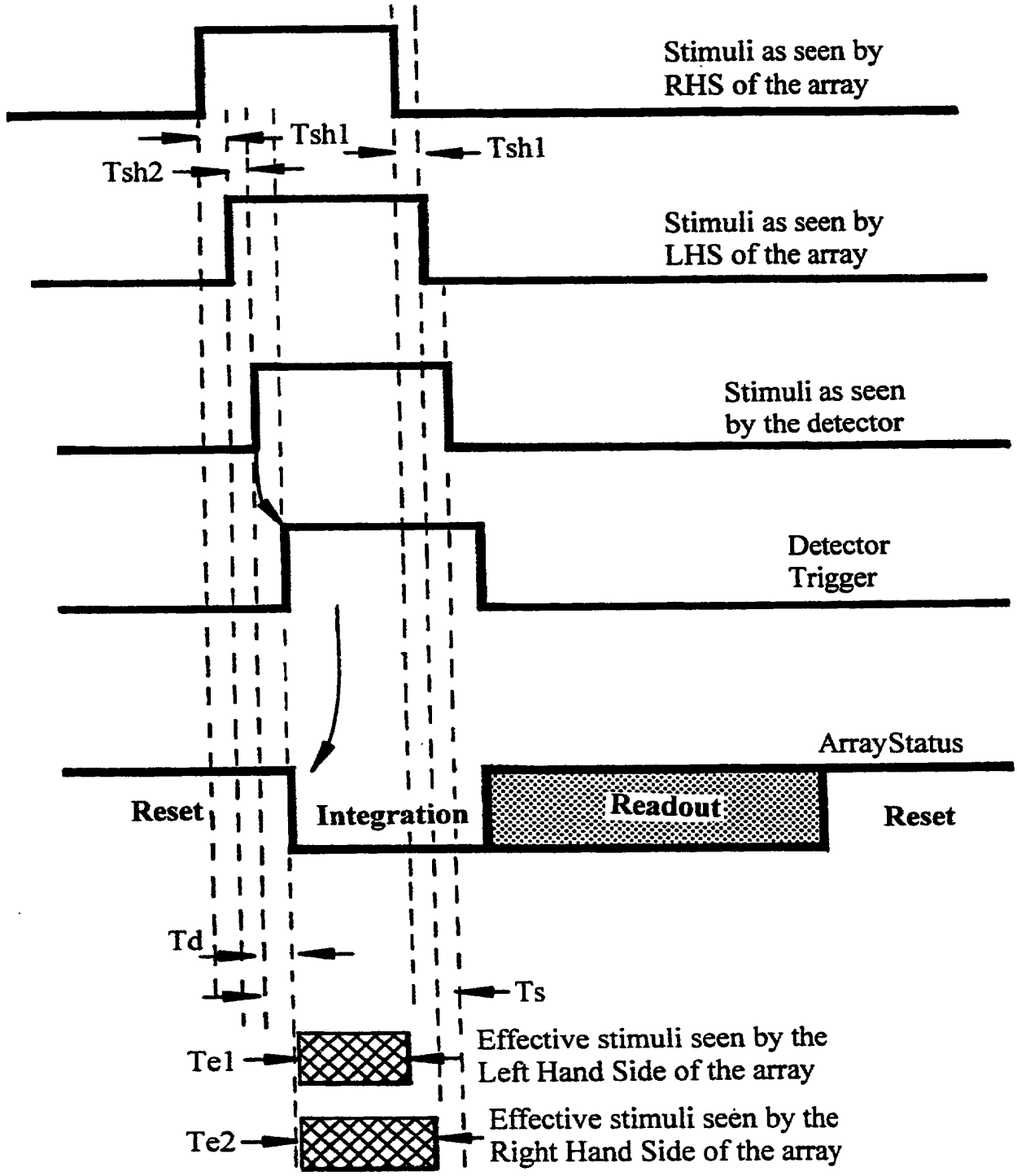
Stimuli as seen by
RHS of the array
Tsh1
Tsh1
Tsh2
Stimuli as seen by
LHS of the array
Stimuli as seen
by the detector
Detector
Trigger
ArrayStatus
Reset
Integration
Readout
Reset
Td
Ts
Tel
Effective stimuli seen by the
Left Hand Side of the array
Te2
Effective stimuli seen by the
Right Hand Side of the array

Fig. 2b

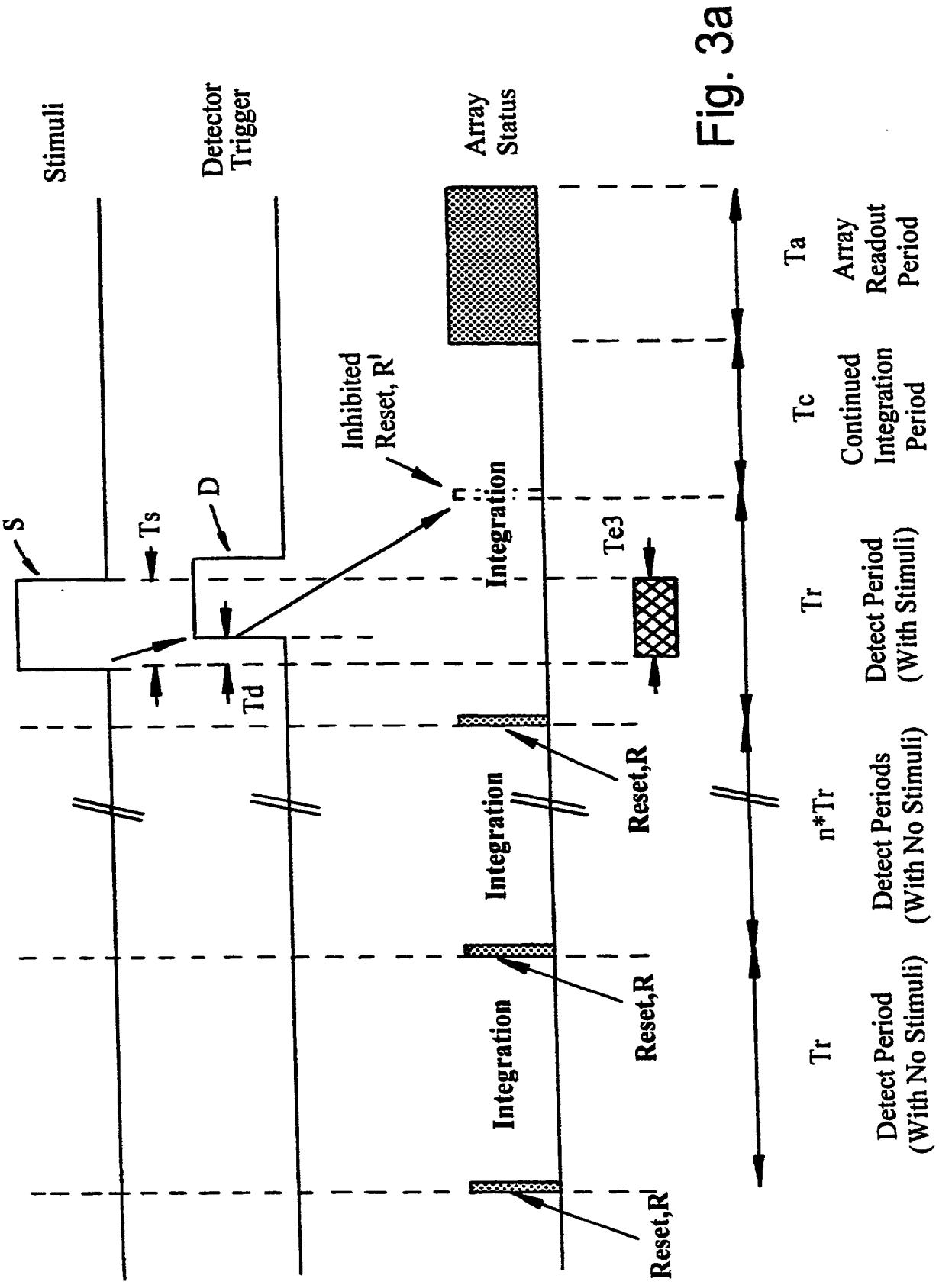
Stimuli
Detector Trigger
Array Status
S
Ts
D
Td
Inhibited Reset, R'
n
Integration
Te3
Reset,R
Integration
Reset,R
Integration
Reset,R'
Ta
Array Readout Period
Tc
Continued Integration Period
Tr
Detect Period (With Stimuli)
n*Tr
Detect Periods (With No Stimuli)
Tr
Detect Period (With No Stimuli)

Fig. 3a

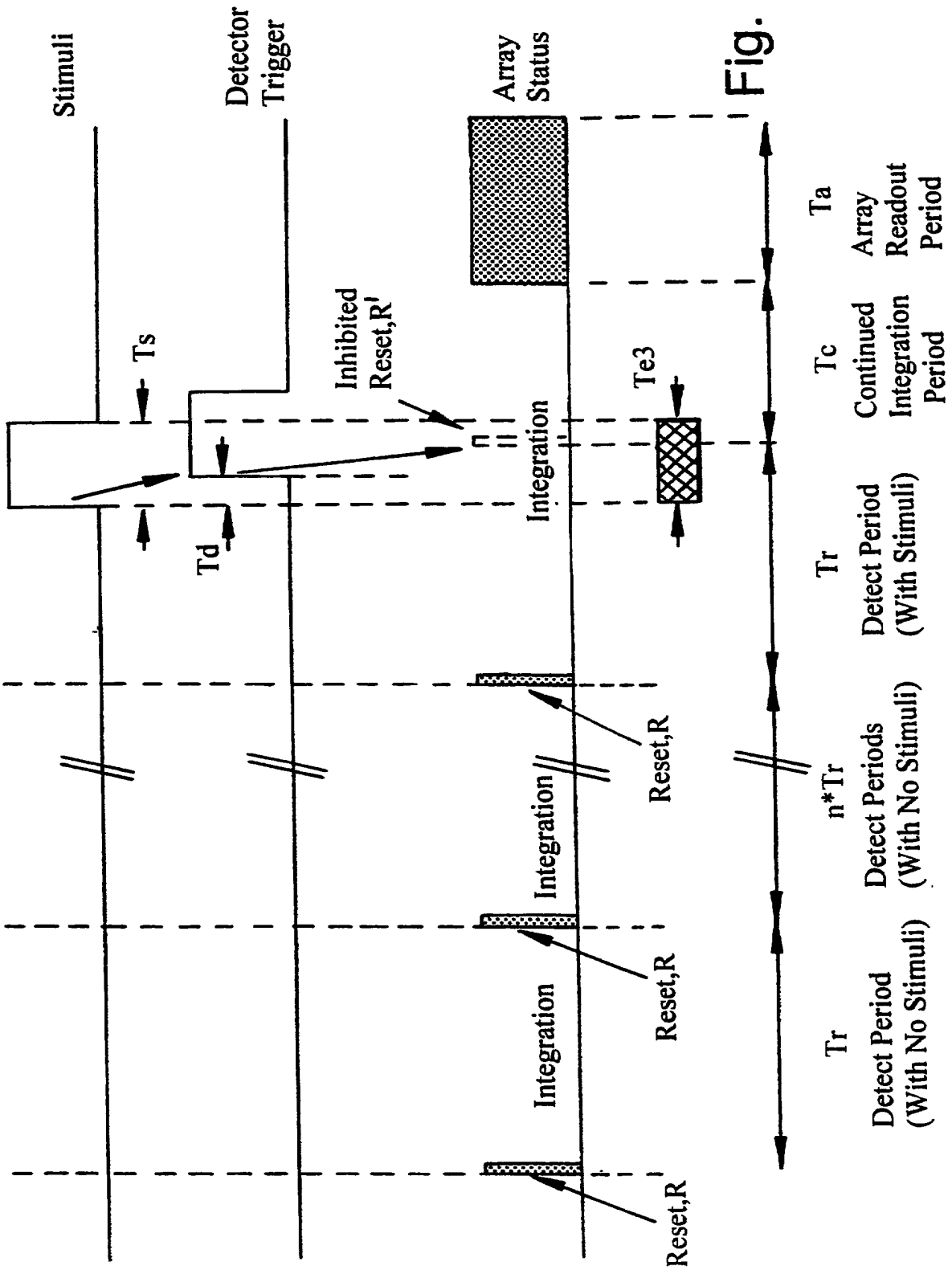
Stimuli
Detector Trigger
Array Status
Ts
Td
Inhibited Reset,R'
Integration
Te3
Reset,R
Integration
Reset,R
Integration
Reset,R
Ta Array Readout Period
Tc Continued Integration Period
Tr Detect Period (With Stimuli)
n*Tr Detect Periods (With No Stimuli)
Tr Detect Period (With No Stimuli)

Fig. 3b

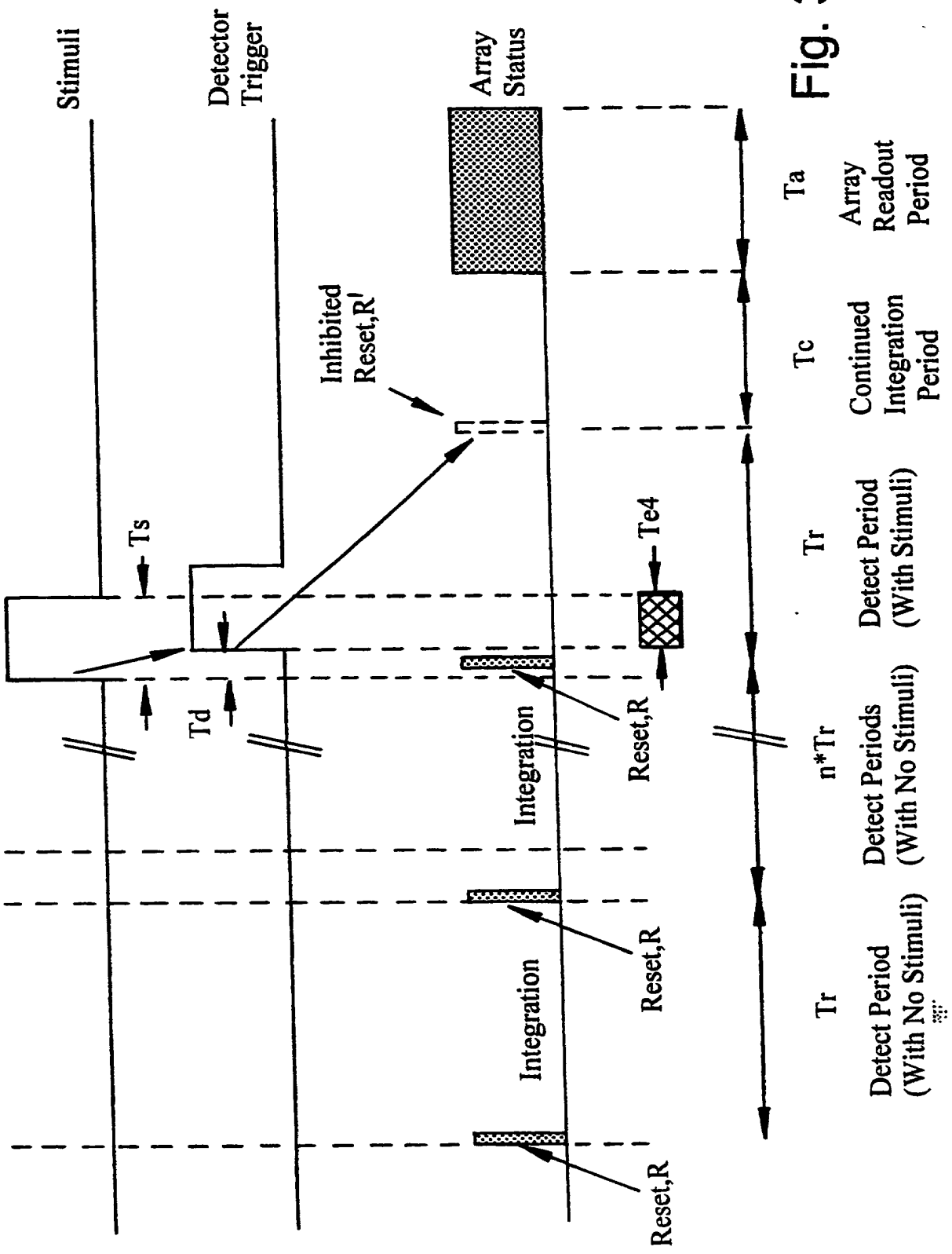
Stimuli
Detector Trigger
Array Status
Inhibited Reset,R'
Ts
Td
Te4
Integration
Reset,R
Integration
Reset,R
Reset,R
Ta
Array Readout Period
Tc
Continued Integration Period
Tr
Detect Period (With Stimuli)
n*Tr
Detect Periods (With No Stimuli)
Tr
Detect Period (With No Stimuli)

Fig. 3c

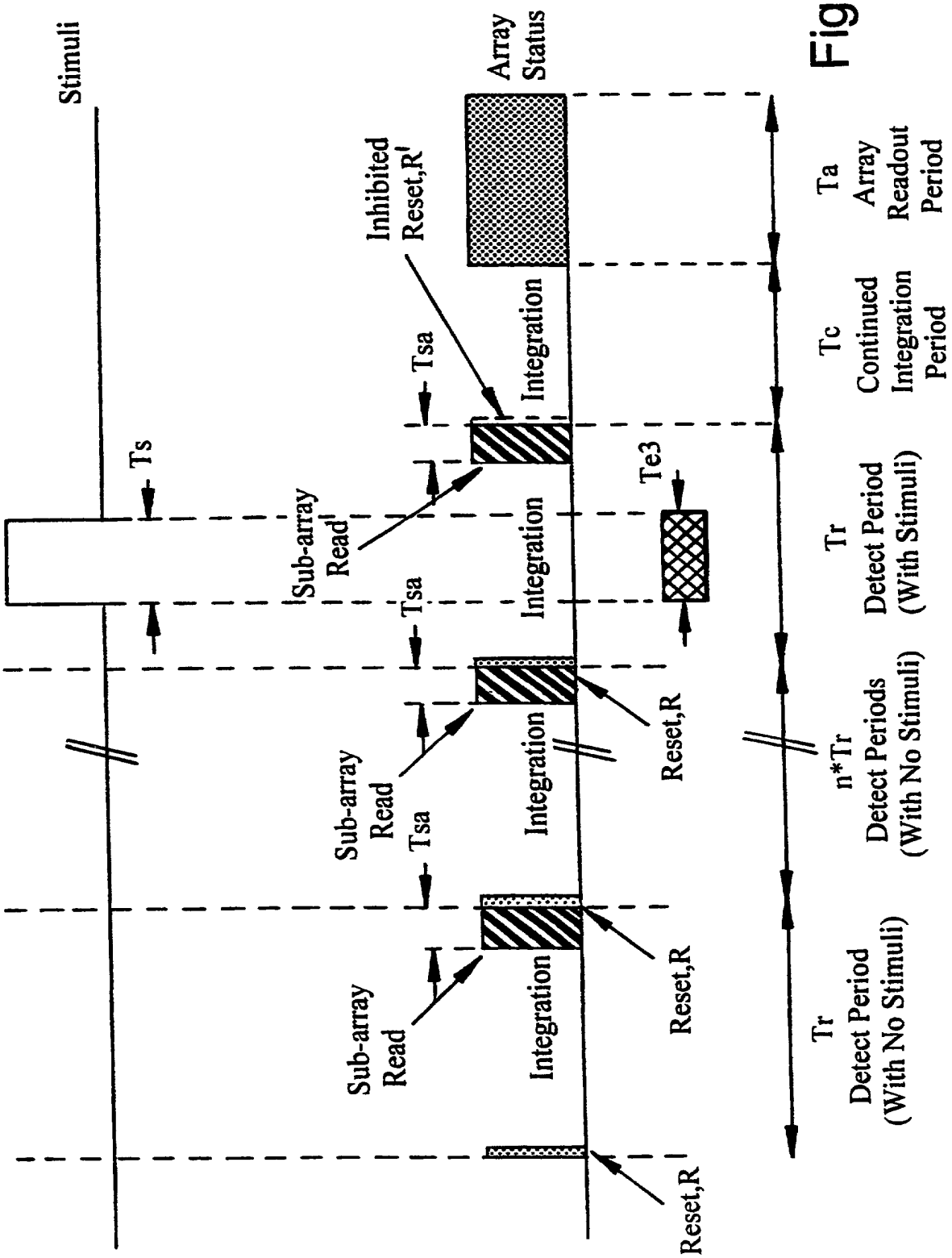
Stimuli
Ts
Array Status
Inhibited Reset,R'
Tsa
Integration
Sub-array Read'
Integration
Te3
Tsa
Sub-array Read
Integration
Reset,R
Tsa
Sub-array Read
Integration
Reset,R
Reset,R
Ta Array Readout Period
Tc Continued Integration Period
Tr Detect Period (With Stimuli)
n*Tr Detect Periods (With No Stimuli)
Tr Detect Period (With No Stimuli)

Fig. 4

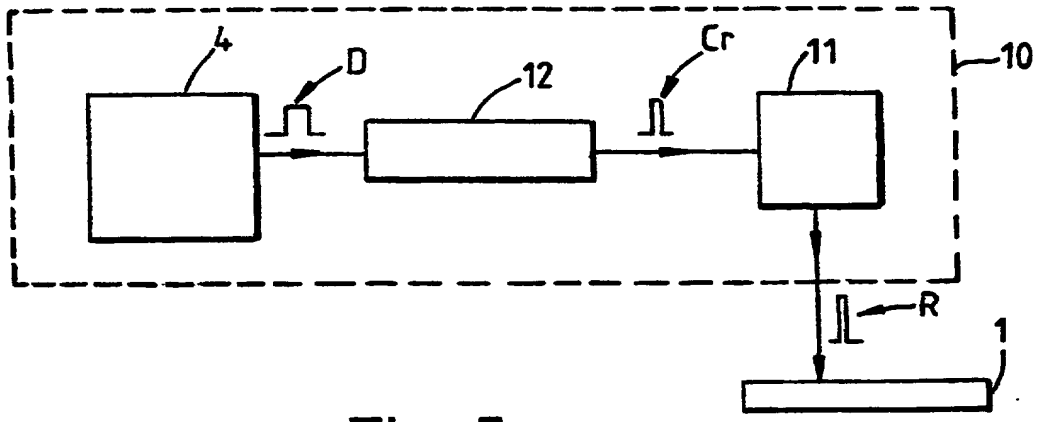

Fig. 5

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DECLARATION FOR UTILITY OR DESIGN PATENT APPLICATION (37 CFR 1.63)

☐ Declaration Submitted with Initial Filing OR ☐ Declaration Submitted after Initial Filing (surcharge (37 CFR 1.16 (e)) required)

Attorney Docket Number	
First Named Inventor	HURWITZ, J.E.D.
COMPLETE IF KNOWN	
Application Number	/
Filing Date	
Group Art Unit	
Examiner Name	

As a below named inventor, I hereby declare that:

My residence, post office address, and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

IMAGE CAPTURE CONTROL

(Title of the Invention)

the specification of which
☐ is attached hereto
OR
☒ was filed on (MM/DD/YYYY) 04/30/1999 as United States Application Number or PCT International Application Number PCT/GB99/01365 and was amended on (MM/DD/YYYY) 05/10/2000 (if applicable).

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment specifically referred to above.

I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR 1.56.

I hereby claim foreign priority benefits under 35 U.S.C. 119(a)-(d) or 365(b) of any foreign application(s) for patent or inventor's certificate, or 365(a) of any PCT international application which designated at least one country other than the United States of America, listed below and have also identified below, by checking the box, any foreign application for patent or inventor's certificate, or of any PCT international application having a filing date before that of the application on which priority is claimed.

Prior Foreign Application Number(s)	Country	Foreign Filing Date (MM/DD/YYYY)	Priority Not Claimed	Certified Copy Attached? YES	Certified Copy Attached? NO
9809482.4	United Kingdom	05/01/1998	☐	☐	☒
			☐	☐	☐
			☐	☐	☐
			☐	☐	☐

☐ Additional foreign application numbers are listed on a supplemental priority data sheet PTO/SB/02B attached hereto:

I hereby claim the benefit under 35 U.S.C. 119(e) of any United States provisional application(s) listed below.

Application Number(s)	Filing Date (MM/DD/YYYY)

☐ Additional provisional application numbers are listed on a supplemental priority data sheet PTO/SB/02B attached hereto.

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DECLARATION — Utility or Design Patent Application

I hereby claim the benefit under 35 U.S.C. 120 of any United States application(s), or 365(c) of any PCT international application designating the United States of America, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT International application in the manner provided by the first paragraph of 35 U.S.C. 112, I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR 1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application.

U.S. Parent Application or PCT Parent Number	Parent Filing Date (MM/DD/YYYY)	Parent Patent Number (if applicable)
PCT/GB99/01365	04/30/1999	

☐ Additional U.S. or PCT international application numbers are listed on a supplemental priority data sheet PTO/SB/02B attached hereto.

As a named inventor, I hereby appoint the following registered practitioner(s) to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith: ☒ Customer Number 826 *OR* ☐ Registered practitioner(s) name/registration number listed below

Place Customer Number Bar Code Label here

Name	Registration Number	Name	Registration Number

☐ Additional registered practitioner(s) named on supplemental Registered Practitioner Information sheet PTO/SB/02C attached hereto.

Direct all correspondence to: ☐ Customer Number or Bar Code Label [ ] *OR* ☒ Correspondence address below

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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under 18 U.S.C. 1001 and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Name of Sole or First Inventor: ☐ A petition has been filed for this unsigned inventor

Given Name (first and middle [if any])	Family Name or Surname
Jonathan Ephriam David	HURWITZ

Inventor's Signature	J.E.D. Hurwitz					Date	22/9/00
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☒ Additional inventors are being named on the 1 supplemental Additional Inventor(s) sheet(s) PTO/SB/02A attached hereto

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DECLARATION

ADDITIONAL INVENTOR(S)
Supplemental Sheet
Page 1 of 1

Name of Additional Joint Inventor, if any:	☐ A petition has been filed for this unsigned inventor						
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Post Office Address							
Post Office Address							
City		**State**		**ZIP**		**Country**	

Name of Additional Joint Inventor, if any:	☐ A petition has been filed for this unsigned inventor						
Given Name (first and middle [if any])			Family Name or Surname				
Inventor's Signature						**Date**	
Residence: City		**State**		**Country**		**Citizenship**	
Post Office Address							
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